Clear Sailing Ahead

Chronology of Clean Fuel and Conservation Efforts

- **2002** WSF began upgrading or replacing the existing fuel-system equipment with more fuel-efficient injectors, main engines, and ship-service generators. So far, 56 engines have been upgraded and 30 generators have been replaced.
- **2003** WSF tested emissions from four different types of fuel, to analyze the potential costs and benefits of switching to cleaner burning fuel.
- **2004** WSF converted its entire ferry fleet to Low-Sulfur Diesel, reducing its emissions of sulfur dioxide and particulates in Central Puget Sound.
- **2004 and 2005** WSF conducted pilot tests of biodiesel (in partnership with Puget Sound Clean Air Agency [PSCAA] and Seattle City Light) and Ultra Low-Sulfur Diesel (in partnership with PSCAA and the U.S. Environmental Protection Agency (EPA).
- **2006** WSF is working with PSCAA and Seattle City Light on a biodiesel research project and second biodiesel pilot test, and has installed fuel monitors on ferries as part of a major fuel-conservation effort.

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Washington State Ferries

Washington State Department of Transportation

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Reducing Diesel Emissions in Washington State: Washington State Ferries Diesel Emissions Reduction

Washington State Ferries is already reducing air pollution by switching to cleaner fuel - and using less of it.

Washington State Ferries (WSF) is the largest ferry system in the nation and a significant user of diesel fuel in Central Puget Sound. The ferries are a vital economic link between the east and west sides of Puget Sound. Commuters depend on ferries to get to work, and businesses depend on ferries to transport goods and services. They are a key tourist attraction during the summer months, connecting visitors to the Olympic Peninsula, Whidbey Island, and the San Juan Islands. For Vashon Island and the San Juan Islands, the state ferry system is the sole means of delivering fuel and commercial goods.

WSF operates 10 ferry routes, from Point Defiance in the south, to Sidney, B.C. in the north, and carries over 24 million riders each year. Every day, WSF vessels travel about 2,500 miles and complete close to 500 sailings. These vessels consume about 18 million gallons of diesel fuel per year.

One quarter of marine vessel fine particulate and nitrogen oxide emissions in Central Puget Sound were from ferry vessels in 2002. Because the ferries operate close to large populations, and some vessels carry up to 2,500 passengers and employees, the ferry system is working hard to burn cleaner fuel and reduce emissions. WSF began this effort in 2002 and 2003. Reducing fuel consumption also helps WSF lower costs and curbs pollution.

WSF Carefully Evaluates its use of Alternative Fuels and Fuel Reduction Strategies

The first step in WSF's clean fuel initiative was to analyze the potential benefits of burning cleaner fuel in the vessels. Between May and September of 2003, the ferry system tested emissions on the M/V Rhododendron, using four different fuels:

1. High-Sulfur Diesel
2. Low-Sulfur Diesel
3. Ultra Low-Sulfur Diesel
4. B-20 (a blend of 20% Biodiesel with 80% Low-Sulfur Diesel)

A Washington State Ferry Moving People in Central Puget Sound

The tests had several purposes:

- To measure emissions for each type of fuel
- To determine compatibility of the different fuels with vessel equipment
- To give WSF personnel experience handling new fuels
- To compare fuel costs

The tests found no operational difficulties with short-term use of lower sulfur, cleaner fuels. Cost-effective reductions in sulfur dioxide (55%) and particulate matter emissions (85%) were achieved by switching from high-sulfur diesel to low-sulfur diesel at an additional cost of approximately $.01 per gallon.

As a result of these tests, WSF decided to move forward with its Clean Fuel Initiative.

Testing and Understanding Biodiesel on Washington State Ferries

Biodiesel is a fuel made from vegetable oils, animal fats, or cooking greases. It contains almost no sulfur and reduces toxic pollutants and greenhouse-gas emissions, although it can emit a bit more nitrogen oxide than regular petroleum diesel.

In 2004, WSF conducted a pilot test of biodiesel on the Fauntleroy-Southworth-Vashon ferry route. The three vessels on this route used a mixture of 20 percent vegetable oil biodiesel and 80 percent low-sulfur petroleum diesel during the pilot test, burning a total of 710,000 gallons of B20 over a four-month period. The cost difference between low-sulfur diesel and the biodiesel blend was funded by Seattle City Light's Greenhouse Gas Mitigation program.

Shortly after the first fueling, all three vessels in the test reported severe clogging in the fuel filters and oil purifiers. Engineers initially thought the clogging was related to start-up. Symptoms continued, however, and after consulting with national fuel industry experts, distributors, and suppliers, WSF suspended the use of biodiesel on the vessels.

WSF is now working with the Puget Sound Clean Air Agency on the next step in testing the use of biodiesel in the marine environment. This Biodiesel Research and Demonstration Project is funded through a federal grant. It is a two-phased project that will include research to identify the correct fuel specifications needed to operate in a Northwest marine environment and a fuel test demonstration to examine the lessons learned.

The study will examine why the problems have occurred. Was it the soybean feedstock itself? Temperature changes during distribution, storage or blending? Problems with the vessels' fuel lines or tanks? The study will attempt to find the cause of the problem, and hopefully a solution, so that WSF can start a second pilot test. WSF will keep the public informed as the study progresses.

Low Sulfur Diesel

WSF analyzed emissions and fuel options in 2003; the entire ferry fleet converted to low-sulfur fuel in 2004. This switch reduced WSF's sulfur dioxide emissions by 412 tons (a 90% reduction) and particulate matter by 75 tons (a 30% reduction). The additional cost to WSF is approximately $150,000 a year.

Testing Ultra-Low-Sulfur Diesel

Beginning in 2004, WSF began testing ultra-low sulfur diesel on the M/V Elwha, which usually serves the Anacortes and San Juan Islands routes. "Ultra low" sulfur diesel produces about 10 percent fewer fine particles than "low" sulfur diesel.

Between fall 2004 and spring 2006, the Elwha burned 2.3 million gallons of ultra low-sulfur diesel fuel. The Puget Sound Clean Air Agency, Washington State Department of Ecology, and Northwest Clean Air Agency contributed funds to this pilot project.

Washington State Ferries Tested Emissions on the M/V Rhododendron in 2003 Using Four Different Types of Fuel

Conserving Fuel Avoids Pollution and Saves Money

In order to cut costs as well as greenhouse gases, WSF is evaluating options to decrease fuel consumption. As a first step, WSF installed fuel monitors on the M/V Wenatchee, M/V Walla Walla, and M/V Chelan. Monitors will be installed soon on other vessels as the evaluation proceeds. Each monitor provides information on how the different vessel types and classes consume fuel during all phases of operation - acceleration, crossing, and deceleration into the dock.

This information is used by WSF's Fuel Conservation Team, which includes staff from the Maintenance, Vessel Engineering, Operations, Planning, and Terminal Engineering departments, to evaluate fuel conservation strategies. Each option is evaluated for potential fuel savings, cost, and impact (if any) on operations.

The options range from relatively easy operational changes, such as decreasing the allowable engine speed on certain vessels, to purchasing and installing new systems. One such system, a fuel conservation-based "cruise control", is currently being tested by British Columbia (Canada) Ferries.

Making Docking Connections and Decreasing Loading Time

One area of focus is the amount of fuel consumed while the vessel is "pushing the dock" during loading and unloading. As ridership has increased, time at the dock (called "dwell time") has also increased, affecting fuel consumption. Engineers are investigating "positive restraint" systems, which would allow the engines to "power down" while the vessel is held in place at the dock. Operations staff are looking at options to decrease the time needed to load and unload vessels.

Profiling to Optimize Routes

In addition, the Fuel Conservation Team is working with vessel captains to "profile" each route. By understanding route characteristics such as number and width of turns per crossing, currents and wind, the team can focus its efforts on routes with the most opportunity for cutting fuel consumption. Through schedule changes and optimized speed choices in 2003, WSF saved nearly a million gallons of fuel and approximately $750,000 in fuel costs.

Heat Recovery

The team is also looking at the potential costs and benefits of installing heat-recovery systems, which would re-use heat generated by the propulsion engines to heat the passenger areas of the vessels. Additional options that will be evaluated for costs and benefits include carrying less total fuel onboard to reduce the vessel's "deadweight", propeller modifications, and different fuel specifications, among others.

Engine Upgrades and Use

Since 2002, WSF has been reducing fleet emissions by upgrading engine equipment. This has included upgrading or replacing fuel injectors, main engines, and ship-service generators. So far, WSF has upgraded 56 engines and replaced 30 generators. Reducing to two engine operation on certain vessel classes can also improve efficiency.

Testing Emissions While Using Alternative Fuels on a Washington State Ferry